Instrument Incubator

Next Generation GNSS Bistatic Radar Receiver

Completed Technology Project (2017 - 2019)

Project Introduction

Global Navigation Satellite System (GNSS) bistatic radars use the existing constellations of navigation satellites (GPS, Galileo, etc.) as the transmit half of a bistatic radar link. The receive half of the link is a customized GNSS receiver designed specifically for remote sensing applications. The current state of the art in these receivers at the TRL-6 or higher level is exemplified by the science payload carried on NASA's CYGNSS mission constellation of small satellites. This receiver demonstrated, during a recent TRL raising technology demonstration mission, that it is capable of measuring ocean surface winds, near surface soil moisture, sea surface height (altimetry), and polar ice extent from low Earth orbit. The current receiver can only process at most four simultaneous measurements and can only use the L1 signal transmitted by the GPS satellite constellation. The use of only L1 signals limits the horizontal resolution (for ocean wind, soil moisture and ice extent applications) and the vertical resolution (for altimetry). The processing of at most four signals and only from GPS satellites limits the spatial sampling and revisit time for all applications. A next generation GNSS bistatic radar receiver will be developed that is capable of processing signals transmitted by both GPS and Galileo satellites, including both low (L1/E1) and high (L5/E5) bandwidth signals. The receiver will also be capable of processing between 7 (minimum) and 14 (goal) simultaneous signals. As a direct consequence of these hardware and firmware developments, horizontal resolution will be improved by a factor of three, vertical resolution by a factor of ten, and spatial coverage and revisit time by a factor of two (minimum) to four (goal). In terms of the impact of these performance enhancements on the scientific value of remotely sensed geophysical properties, the improvements range from significant but incremental to fundamentally enabling. Examples of significant incremental improvements are the measurement of ocean surface winds and ice extent. The improved spatial resolution will, for example, enable finer spatial scale structure to be resolved in storms and smaller leads and tongues to be imaged at the polar ice edge. Examples of enabling improvements are in the areas of sea level change and flood prediction. The ability to measure sea surface height with 10X higher accuracy will place GNSS methods in the same general range of performance as existing satellite altimeter missions. The ability to measure soil moisture with high spatial and temporal resolution will enable soil saturation monitoring during potential flash flood events. In these and other ways, the next generation GNSS bistatic radar receiver will enable major improvements in climate studies, weather monitoring and prediction, disaster management, and uses by commercial maritime organizations. This three year effort will raise the technology readiness of a Next Generation GNSS Bistatic Radar Receiver from TRL-4 to TRL-6.

Next Generation GNSS Bistatic Radar Receiver

Table of Contents

Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Lead Organization:

University of Michigan-Ann Arbor

Responsible Program:

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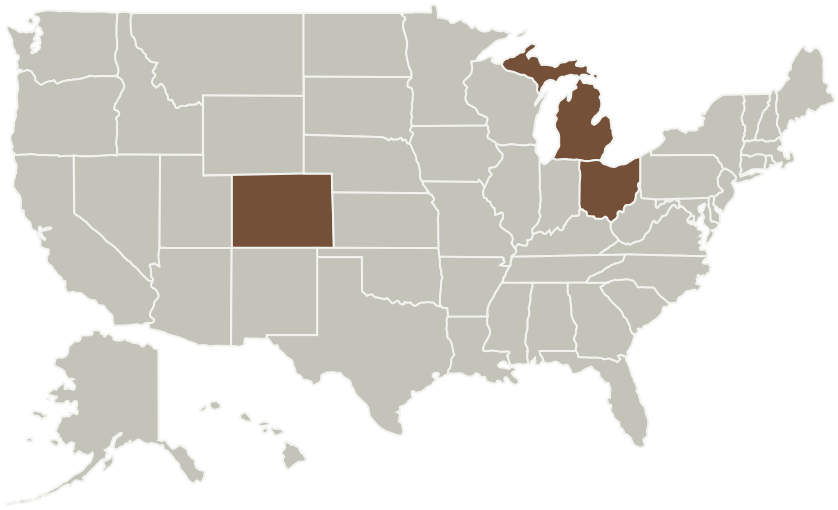
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
University of Michigan-Ann Arbor	Lead Organization	Academia	Ann Arbor, Michigan

Primary U.S. Work Locations	
Colorado	Michigan
Ohio	

Project Management

Program Director:
Pamela S Millar

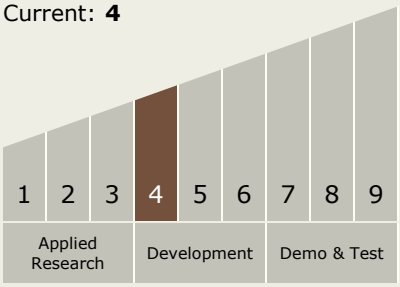
Program Manager:
Parminder S Ghuman

Principal Investigator:
Christopher S Ruf

Co-Investigators:
Linda Brooks
Scott Gleason
Chi-chih Chen
Andrew J O'brien

Technology Maturity (TRL)

Start: **4**
Current: **4**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

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Target Destination

Earth